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Putting $a=2, b=3, c=4, d=5, \dots$ we get

$$\frac{1}{2} + \frac{1}{2 \cdot 3} + \frac{1}{2 \cdot 3 \cdot 4} + \dots = \frac{1}{2} - \frac{2}{4} + \frac{3}{5} - \frac{4}{6} + \frac{5}{7} - \dots$$

$$\text{Hence } e=2 + \frac{1}{2} - \frac{2}{4} + \frac{3}{5} - \frac{4}{6} + \frac{5}{7} - \dots$$

Also solved by G. W. Greenwood, and G. B. M. Zerr.

264. Proposed by O. E. GLENN, Ph. D., Springfield, Mo.

Express the invariant $2(a_0a_4 - 4a_1a_3 + 3a_2^2)$ of the binary quartic $a_0x_1^4 + 4a_1x_1^3x_2 + 6a_2x_1^2x_2^2 + 4a_3x_1x_2^3 + a_4x_2^4$ in terms of roots of the latter.

Solution by G. W. GREENWOOD, M. A., McKendree College, Lebanon, Ill.

It can be shown that, if

$$\begin{aligned} & a_0x_1^4 + 4a_1x_1^3x_2 + 6a_2x_1^2x_2^2 - 4a_3x_1x_2^3 + a_4x_2^4 \\ & \equiv a_0(x_1^2 + 2px_1x_2 + qx_2^2)(x_1^2 + 2p'x_1x_2 + q'x_2^2), \end{aligned}$$

then $4\theta^3 - I\theta + J = 0$, where $I = a_0a_4 - 4a_1a_3 + 3a_2^2$, and $\theta = a_2 - a_0pp'$.

Let β, γ be the roots of $x_1^2 + 2px_1x_2 + qx_2^2 = 0$, and a, δ the roots of $x_1^2 + 2p'x_1x_2 + q'x_2^2 = 0$. Then

$$\theta = \frac{a_0}{6} \Sigma \beta\gamma - \frac{a_0}{4}(\beta + \gamma)(a + \delta) = \frac{a_0}{12}(v - w),$$

where $u = (\beta - \gamma)(a - \delta)$, $v = (\gamma - a)(\beta - \delta)$, $w = (a - \beta)(\gamma - \delta)$. The roots of the reduced cubic are therefore,

$$\frac{a_0}{12}(u - v), \frac{a_0}{12}(v - w), \frac{a_0}{12}(w - u).$$

It is easily found that $u + v + w = 0$. Consequently, $\Sigma vw = -\frac{1}{2} \Sigma u^2$, and

$$\frac{I}{4} = - \Sigma \theta_1 \theta_2 = - \frac{a_0^2}{144} \Sigma (uv - uw + vw - v^2) = \frac{a_0^3}{144} \cdot \frac{3}{2} \Sigma u^2.$$

Hence $I = \frac{a_0^2}{24} \Sigma u^2$, where u, v, w have the values given above.

Also solved by G. B. M. Zerr.